

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY


(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

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| Applicant's or agent's file reference 62829A | FOR FURTHER ACTION | | See Form PCT/PEA/416 |
| International application No. PCT/US2005/003772 | International filing date (day/month/year) 04.02.2005 | Priority date (day/month/year) 09.02.2004 | |
| International Patent Classification (IPC) or national classification and IPC C07C5/333 | | | |
| Applicant DOW GLOBAL TECHNOLOGIES INC. | | | |
| <p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 8 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input type="checkbox"/> sent to the applicant and to the International Bureau) a total of sheets, as follows:</p> <p><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (Indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p> | | | |
| <p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input checked="" type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p> | | | |
| Date of submission of the demand 01.12.2005 | | Date of completion of this report 22.02.2006 | |
| Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465 | | Authorized Officer Slootweg, A Telephone No. +49 89 2399- | |



**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/US2005/003772

Box No. 1 Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

Description, Pages

1-16 as originally filed

Claims, Numbers

1-20 as originally filed

Drawings, Sheets

1/5-5/5 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/US2005/003772

Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application,

☒ claims Nos. 1-20 (part)

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (specify):

☐ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. are so unclear that no meaningful opinion could be formed (*specify*):

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☒ no international search report has been established for the said claims Nos. 1-20 (part)

☐ the nucleotide and/or amino acid sequence listing does not comply with the standard provided for in Annex C of the Administrative Instructions in that:

the written form

☐ has not been furnished

☐ does not comply with the standard

the computer readable form

☐ has not been furnished

☐ does not comply with the standard

☐ the tables related to the nucleotide and/or amino acid sequence listing, if in computer readable form only, do not comply with the technical requirements provided for in Annex C-*bis* of the Administrative Instructions.

☐ See separate sheet for further details

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/US2005/003772

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | |
|-------------------------------|-------------|------------------|
| Novelty (N) | Yes: Claims | 2-4,8-9,11,13-20 |
| | No: Claims | 1,6,7,10,12 |
| Inventive step (IS) | Yes: Claims | |
| | No: Claims | 1-20 |
| Industrial applicability (IA) | Yes: Claims | 1-20 |
| | No: Claims | |

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item III.

1. Claim 1 refers to a process for dehydrogenation of a hydrocarbon selected from paraffinic- and alkylaromatic- hydrocarbons. There is no limit to the amount of carbon atoms present making it sheer impossible to search the whole scope of the claims. The search was, therefore, restricted to the hydrocarbons identified in the application, namely those identified in claim 6.
2. In claim 1 the reaction should be performed in concurrent flow and with a contact time between the hydrocarbon and the catalyst within the reactor is from **about** 0,5 to **about** 10 seconds. The term **about** is considered unclear and as such to render the feature of contact time unclear (Art. 6 PCT). The concurrent flow has been understood to be a process wherein the catalyst and the reactants move in the same direction through the reactor, and the contact time has been taken to be between 0,5 and 10 seconds.
3. It is considered that the use of contact time between the reactant and the catalyst is unusual. Usually the flow of reactant is defined as the volume or weight flow of gaseous reactant per volume or weight of catalyst per unit time (gas hourly space velocity or GHSV). The use of the average contact time made it impossible to compare the presently claimed subject-matter with the prior art. This feature was not taken to limit the search.
4. Due to the above problems the search cannot be considered complete and to only cover a process for dehydrogenation of the hydrocarbons as defined in claim 6, in a catalytic manner where the catalyst and reactants are fed in concurrent flow through the reactor.
5. Although claims 17 and 18 have been worded as independent claims, they appear to be in fact de facto dependent claims describing preferred reaction features. They have, therefore, been considered as claims dependent on claim 1.

Re Item V.

6. Reference is made to the following documents:

- D1 : WO 01/44146 A (THE DOW CHEMICAL COMPANY; COCCO, RAYMOND, A;
CASTOR, WILLIAM, M) 21 June 2001 (2001-06-21)
D2 : EP 0 577 280 A (EXXON RESEARCH AND ENGINEERING COMPANY) 5
January 1994 (1994-01-05)
D3 : US 2 921 102 A (LOWMAN MALDEN CARR) 12 January 1960 (1960-01-12)
D4 : WO 93/12879 A (EXXON RESEARCH AND ENGINEERING COMPANY) 8
July 1993 (1993-07-08)

7. The term "about" used in claims 1-5, 10-12 and 17-18 is vague and unclear and leaves the reader in doubt as to the meaning of the technical features to which it refers, thereby rendering the definition of the subject-matter of said claims unclear, Article 6 PCT.

Novelty

8. The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1, 6, 7, 10 and 12 is not new in the sense of Article 33(2) PCT.

Document D1 discloses in the examples processes for dehydrogenation of hydrocarbons (in the examples ethylbenzene) and a temperature and pressure of from 550 to 650°C and 1 to 73 psia (as defined in claims 13 and 14 of D1, and at 600°C and 15,5 psia in for example example 1 of D1).

From the description of D1, p. 13, l. 24 to p. 14, l. 2 it is considered clear that in the dehydrogenation zone, especially in the reactor shown in figure 2, the catalyst and the reactants move concurrently. Although the contact time of the hydrocarbon with the catalyst are not indicated in the examples, they are assumed to be within the range given in claim 1 especially since the GHSV of the hydrogenation feedstream is defined to be between 60 and 12000 h⁻¹ (see claim 15 of D1) which has been recalculated to correspond to from 0.3 to 60 seconds, and thus lie in the claimed range.

9. The document D2 concerns the dehydrogenation hydrocarbons (of isobutane to isobutene in the examples) by means of catalytic dehydrogenation where the

catalyst and reactants pass concurrently through the reactor (see p. 3, col. 4, l. 50 to p. 4, col. 5, l. 17 of D2). The reaction is performed at a temperature of from 400 to 1200°C (see claim 1) and under a pressure of from 0.1 to 5 atmospheres (see claim 5 of D2, corresponding to 1.47 to 73.5 psia). Although in the examples no indication is made of the contact time of the catalyst and the hydrocarbon, it is indicated that the hydrocarbon has a vapour residence time of 1 second (this is considered to be the contact time). The examples are, therefore, considered to fall under the definitions given in claims 1, 6, 10 and 12 which are, therefore, considered not to satisfy the requirements of Art. 33 (2) PCT.

10. Document D3 discloses a catalytic dehydrogenation process for dehydrogenation of hydrocarbons at a temperature of above 1000°F (537.7°C, at 1100°F or 593.3°C for the dehydrogenation of n-butane to n-butene in the example) in a "riser" reactor, where the catalyst and hydrocarbon are transported concurrently through the reactor. Although no contact time is indicated in the example it is indicated in the description of D3 that the hydrocarbons will "usually be in the reactor under 5 seconds". Thus the contact time is considered to be under 5 seconds in D3. The example of D3 is, therefore, considered to fall under the definition of at least claims 1, 6, 10, and 12 of the present application (Art. 33 (2) PCT).

Inventive steps

11. D4 discloses catalysts containing gallium and alumina for the dehydrogenation of light paraffins (hydrocarbons) in the examples propane to propene. The process is indicated to be run at a pressure of from 5-60, preferably 10-30 psia, 450-750, preferably 525-625 °C, and GHSV of 400-4000, preferably 600-2000 h⁻¹). It is indicated in D4 that Standard conditions used for the studies were 605 °C, 1 atm pressure, and GHSV of 2000 h⁻¹ (2 second contact time). The only difference between claim 1 and D4 is then, that claim 1 of the present application defines that the process is concurrent. D4, however, does not define how the reaction is performed and is, therefore interpreted to also include a concurrent process. Claim 1 must, therefore, be considered to be a selection

**INTERNATIONAL PRELIMINARY
REPORT ON PATENTABILITY
(SEPARATE SHEET)**

International application No.

PCT/US2005/003772

from D4 where the reaction is run in concurrent mode. Such a way to perform dehydrogenation reactions is, however, known from the prior art documents D1-D3. It would, therefore, be obvious for the skilled man to combine the teachings of D4 with either D1-D3 and so come to the subject-matter claimed in claim 1 and 15 (Art. 33 (3) PCT).

12. It is not clear from the present application what special importance is associated with the features defined in dependent claims 2-5, 8-9, 11, and 13-20; namely what problem they solve. The features of the dependent claims are either known from D1-D4 or are considered to be rendered obvious thereby.
13. The units of pressure (psia) employed in claims 10-11, and 17 and in the description are not additionally expressed in terms of the units stipulated by Rule 10.1(a) and (b) PCT.
14. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1-D4 is not mentioned in the description, nor are these documents identified therein.